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Revision and stabilisation surgery of an adult degenerative scoliosis

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Keywords Adult degenerative scoliosis · Scoliosis and spondylolisthesis L5/S1 · Revision of DIAM implant · Decompression

Learning targets

- To understand the character of a progressive adult degenerative scoliosis and its indication for surgery.
- To understand the aetiology of adult degenerative scoliosis.
- To understand the contraindication of dynamic fixation in lumbar degenerative and progressive scoliosis.

Introduction

Adult degenerative scoliosis, be it "de novo" as a basically multilevel disc disease or be it as a secondary degenerative scoliosis in combination with a lumbosacral anomaly like spondylolisthesis or hemisacralization, are today common pathologies in specialised spine centres [1]. There is very little evidence that conservative non-surgical treatment in progressive painful adult deformities very often combined with spinal stenosis and therefore claudication symptomatology or in the worst combined with neurological deficit is successful. In many of these pathologies, the only viable option for patient's quality of life is surgery, as long as the general condition and also the age allow such an extensive surgery.

Although this surgery has been described with a high incidence of complications, the patients who have been treated successfully for complications as well as those who do not make any complications show in general a quite satisfying result [2, 3]. Usually the progression can be stopped and a resulting invalidating deformity can be avoided. If the deformity is combined with spinal stenosis, an appropriate direct microsurgical decompression or an indirect decompression by reducing and correcting the deformity allows the patients in most cases to improve their walking distance and their quality of life.

Many different surgical procedures are available to treat this kind of pathology [4]. Sometimes it is sufficient to treat specifically early on strategically the main source of the scoliosis in the apex or below the apex with a uni- or bi-segmental fixation; in some cases, there is a need for maximal fixation from the thoracic spine to the pelvis and sacrum [5]. This presented case has been operated for a spinal stenosis at L4/5 with a DIAM implant, which has not resolved the problem and necessitates a more extensive surgery [6]. In addition, many of these deformities in elderly women are combined with significant osteopenia or osteoporosis and make a fixation quite difficult.

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Case description

This 75-year-old lady with a polymyalgia, which has been treated for a long time with steroids with consecutive osteopenia, had surgery 2 years before, bilateral microsurgical decompression at L4/5 from the right side over the top to the left side. The segment was then fixed with a semi-rigid interspinous fixation device (DIAM). This patient also had hip arthroplasties on both sides and a recent revision a year before the index surgery on the right side. Because of the osteopenia, the patient takes Calcimagon. The patient suffers from invalidating back pain, which is mostly localised over the lower lumbar spine and on the other side irradiating into both buttocks and partially to the right thigh. This irradiating pain is not clearly following a spinal root.

Radiologically, this patient has a translational dislocation at L2/3 at the apex of a lumbar curve in a progressive degenerative scoliosis with only moderate kyphosis. She still has an acceptable sagittal alignment, so the decision was taken to do the correction through facet osteotomies, may be Smith-Petersen osteotomy, but without any transpedicular resection osteotomy. The curve is pretty well in balance in the frontal plane and the pelvis seems to be horizontal. Besides the deformity in the frontal as well as in the sagittal plane, there is also spondylolisthesis at L5/S1 as well as a slight secondary spondylolisthesis at the level of L4/5. The traction films demonstrate a partial correction of the scoliosis.

The pain of the patient can be mostly interpreted as pain due to the collapse of the spine in the upright position, since the patient is almost pain free as long as she lies in bed. By correcting and aligning the spine, there is already a high probability of at least a partial decompression of the narrow canal, which is mostly at L2/3 and partially at L4/5, where a DIAM has been implanted. The crucial question in this patient is how far up in the lumbar spine or even in the thoracic spine the fixation has to go. Under traction it seems that L2 can be more or less horizontalized and therefore the question arises whether the fixation to L2 would be sufficient. However, the disc space L1/2 is partially narrowed and the disc is certainly degenerated. In case L2 and L1 cannot be horizontalized sufficiently, and therefore the counter curve in the thoracic spine cannot be partially compensated, then the fixation has to go into the lower thoracic spine, i. e., from L1 to T11/12. This again implies with the well-known osteopenia of this patient that there may be secondary osteoporotic fractures in the adjacent segments above the rigid fixation. The patient has been informed that everything will be tried to limit the fixation to L2 and going to the sacrum. Since there is no major pelvic obliquity, the decision has been taken not to include the pelvis in the fixation and to limit the fixation to the sacrum.

Surgical strategy

The patient is operated on in general anaesthesia with controlled hypotension to limit blood loss and with neuromonitoring. The patient is in prone position, fixed on two rolls, one under the breast and the other one under the pelvis, leaving the abdomen freely hanging and without any external pressure. This position allows in cases with a relatively unstable kyphosis, respectively, scoliosis to partially correct the kyphosis through the positioning of the patient.

A line is designed with a marking pen from the spinous process of C7 to the rima ani. This will be the incision line independent from the curve.

After a straight incision from about L1 to the sacrum, the spinous processes are identified after mobilising the subcutaneous fat tissue. From the tips of the spinous processes, the paravertebral muscles are dissected from the spinous processes and the arches of the vertebrae from L1 to S2. The facet joints are identified. The capsules of the facet joints of L2/3, L3/4, L4/5, and L5/S1 are resected with the electric knife. The joints are mobilised with partial osteotomies of the joint surfaces. The interspinous tissue is removed, so the segments can individually be distracted and manipulated. The pedicle entry points for L2, L3, L4, L5 and S1 are identified and pedicle screws are positioned. Since the joints L4/5 respectively the anatomy is poorly visible due to previous DIAM surgery, we used the image intensifier to make sure that we opened the right pedicle and in the right direction. Pedicle screws are positioned in the pedicles from L2 to S1, and in S1 8 mm cancellous thread of the pedicle screws is inserted. All screws are firmly fixed in the bone in spite of osteopenia. These pedicle screws are positioned on both sides. The screws in S1 are put very closely to the endplate of S1 to have the best bone in the subchondral area of the endplate. Rods are pre-bent and put into the screw heads after it has been checked that all joints are freely mobile from L2 to S1. The pre-bending of the rods includes a lordosis. The pedicle screws at L2 are well horizontalized. The whole curve seems to be well corrected. At this point, we decided not to expand the fixation into the lower thoracic spine. The introduction of the rod on the concave side with pulling the screws towards the rod leads to a derotation and correction of the curve. The screw heads are compressed along the rods on both sides to create lordosis.

After positioning the rods and fixing them in the screws, the segment L2/3 is now opened microsurgically with loops. We start in the midline and we perform a laminotomy from the midline to the lateral side on the left as well as on the right side until we are convinced that there is enough space for the dural sac. This is palpated with the curved Steffee dissector with which we can also check whether the foramina and the recessus are free.

Even before inserting the rods for the correction of the curve, the DIAM implant at L4/5 has been removed. It has been heavily fixed in scar tissue between the spinous processes. It seems like a connective tissue capsule around this implant. After removing this implant, also the interspinous space at L4/5 is decompressed by undercutting the laminas of L4 and L5 on both sides. At the level of L5/S1, the spinal canal is opened just to be sure that the pedicle screws are firmly in S1 and have no conflict with the exiting roots of L5 and S1. After proper reduction and fixation and tightening of the screws and sufficient decompression, the breaches are covered with Gelfoam and a posterolateral fusion is done with the spinous processes which are cut in small pieces and mixed with demineralized bone matrix to augment the mass of the bone. A redon drainage is applied and the wound is closed in layers.

During the whole surgery, the neuromonitoring was normal and there were no indications for any neurological hazards during the surgery. After the surgery, the patient moved both legs immediately.

Postoperative information

This patient is mobilised the first day after surgery through a sitting position at the border of the bed. At the beginning, she walks with crutches or with an Eulenburg to give security. She also starts with preoperatively isometric exercises for the abdominal and back muscles. During the surgery and the first 24 h after, as long as the patient had a bladder catheter, she is under prophylactic antibiotics. As soon as the bleeding through the drainage is under control, the patient can be prophylactically treated with Fraxiparine in addition to the antithrombotic stockings to avoid thromboembolism. The patient will carry a lumbar belt with reinforcements in the back for the first 6 to 12 weeks.

This relatively short degenerative lumbar scoliosis, most probably caused by a spondylolisthesis at the level of L5/S1 and a degenerative spondylolisthesis with spinal stenosis at L4/5 and a treatment with an interspinal spacer (DIAM), was stabilised and corrected with a relatively short fixation from L2 to the sacrum. Due to this short fixation, the fixation has not been introduced into the pelvis. Through the horizontalization of L1, the spine above L2 was let alone without any fixation and the potential to correct to a certain degree spontaneously the counter curve. The loss of lordosis was very moderate and the sagittal alignment still acceptable for a 75-year-old lady. For this reason, we have stayed away from doing any transpedicular reduction osteotomies. We have osteotomized the small joints to give certain mobility per segment and give a certain lordotic correction when applying tension banding in the back over the rods. Obviously, this instrumented fixation needs to be supported by a proper fusion to avoid non-union or breakage or loosening of screws and rods in a mid- to long-term. In this specific case, there was no need to do augmentation with cement for the screws, since the screws showed pretty good purchase in the bone.

Due to the strong purchase of the S1 screws in the sclerotic endplate, no additional surgery for anterior column support was considered.

The postoperative major problem was persisting pain in the buttocks, which was difficult to attribute to the surgery, since the patient has a long-term history of polymyalgia. From the pain situation, there was big hesitation to do the surgery because there was a realistic probability that this surgery will not change the patient's pain pattern, which existed for many years. However, the fact that this curve was progressive made it necessary to do this surgery, independent from whether the pain could be influenced in a beneficial way or not.

Conflict of interest None.

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